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IS 10535 (1983): Manganese sulphate, monohydrate [CHD 1: Inorganic Chemicals]



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IS : 10535 - 1983

*Indian Standard*  
SPECIFICATION FOR  
MANGANESE SULPHATE, MONOHYDRATE

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**INDIAN STANDARDS INSTITUTION**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

# *Indian Standard*

## SPECIFICATION FOR MANGANESE SULPHATE, MONOHYDRATE

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# *Indian Standard*

## SPECIFICATION FOR MANGANESE SULPHATE, MONOHYDRATE

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 15 March 1983, after the draft finalized by the Inorganic Chemicals ( Misc ) Sectional Committee had been approved by the Chemical Division Council.

**0.2** Manganese sulphate is used as animal feed, in the paint and varnish industry, in the manufacture of oxalate and borate driers, ingredient of drying compositions, varnishes and boiled linseed oil manufacture and drier for pale oils. Use of the material by the electroplating industry, textile dyeing, calico printing, ceramics and paper manufacture is gradually growing.

**0.3** Manganese sulphate is used in the manufacture of electrolytic manganese dioxide by electrolysis process, which finds application in the manufacture of dry battery cells.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard prescribes the requirements and methods of sampling and test for manganese sulphate, monohydrate.

**1.1.1** It does not cover manganese sulphate as micronutrient and manganese sulphate used by pharmaceutical industry.

### 2. GRADES

**2.1** The material shall be of the following two grades:

*Grade 1 and Grade 2*

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Rules for rounding off numerical values ( revised ).

**2.1.1** *Grade 1* of the material shall be of pure grade which is the direct finished product.

**2.1.2** *Grade 2* of the material shall be of technical grade which is the by-product of other processes.

### **3. REQUIREMENTS**

**3.1 Description** — The material shall be in the form of pale pink to almost pinkish powder or as liquid.

**3.2** The material when tested according to the methods prescribed in Appendix A shall comply with the requirements given in Table 1. Reference to the relevant clauses of Appendix A is given in col 5 of the table.

### **4. PACKING AND MARKING**

**4.1 Packing** — The material shall be packed in polyethylene laminated jute bags or as agreed to between the purchaser and the supplier.

**4.2 Marking** — Each package shall bear legibly and indelibly the following information:

- a) Name and grade of the material;
- b) Name of the manufacturer and his recognized trade-mark, if any;
- c) Gross and net mass;
- d) Date of packing; and
- e) Lot number.

**4.2.1** The packages may also be marked with the ISI Certification Mark.

**NOTE** — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

### **5. SAMPLING**

**5.1** Representative samples of the material shall be drawn and adjudged as prescribed in Appendix B.



**TABLE 1 REQUIREMENTS FOR MANGANESE SULPHATE, MONOHYDRATE**

( Clause 3.2 )

Sl No.	CHARACTERISTIC	REQUIREMENT		METHOD OF TEST, REF TO CL No. IN APPENDIX A
		Grade 1	Grade 2	
(1)	(2)	(3)	(4)	(5)
i)	Manganese sulphate ( as $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ ), percent by mass	97.0—98.0	83.0—85.0	A-2
ii)	Manganese ( as Mn ), percent by mass	31.60—31.95	27.01—27.70	A-3
iii)	Insoluble matter, percent by mass, <i>Max</i>	0.02	0.5	A-4
iv)	Chloride ( as Cl ), percent by mass, <i>Max</i>	0.03	0.03	A-5
v)	Magnesium and alkali metals ( as $\text{SO}_4$ ), percent by mass, <i>Max</i>	0.6	—	A-6
vi)	Calcium ( as Ca ), percent by mass, <i>Max</i>	0.2	—	A-7
vii)	Zinc ( as Zn ), percent by mass, <i>Max</i>	0.05	0.05	A-8
viii)	Iron ( as Fe ), percent by mass, <i>Max</i>	0.005	0.08	A-9
ix)	Heavy metals ( as Pb ), percent by mass, <i>Max</i>	0.002	0.05	A-10
x)	Arsenic ( as As ), percent by mass, <i>Max</i>	0.000 5	—	A-11
xi)	Oxygen absorbed from permanganate ( as O ), percent by mass, <i>Max</i>	0.000 8	—	A-12
xii)	Ammonium sulphate [ as $(\text{NH}_4)_2\text{SO}_4$ ], percent by mass, <i>Max</i>	—	15	A-13

## A P P E N D I X    A

( Clause 3.2 )

### METHODS OF TEST FOR MANGANESE SULPHATE, MONOHYDRATE

#### A-1. QUALITY OF REAGENTS

**A-1.1** Unless specified otherwise, pure chemicals and distilled water ( see IS : 1070-1977\* ) shall be employed in tests.

NOTE — ' Pure chemicals ' shall mean chemicals that do not contain impurities which effect the results of analysis.

#### A-2. MANGANESE SULPHATE

**A-2.0 Outline of the Method** — Manganese is converted to manganese sulphate, monohydrate.

##### A-2.1 Calculation

Manganese sulphate, monohydrate  
( as  $\text{MnSO}_4 \cdot \text{H}_2\text{O}$  ) percent by mass =  $A \times 3.073$

where

$A$  = percentage of manganese as calculated in **A-3**.

#### A-3. DETERMINATION OF MANGANESE

**A-3.1** Determine manganese content according to **9.3** of IS : 1473-1960†.

#### A-4. DETERMINATION OF INSOLUBLE MATTER

**A-4.1 Procedure** — Dissolve 10 g of the sample in 100 ml of water and heat for 30 minutes on a steam bath. Filter any undissolved matter through a tared sintered glass crucible ( G-4 ), wash thoroughly with water, dry at 105°C, cool in a desiccator and weigh.

##### A-4.2 Calculation

Insoluble matter,  
percent by mass =  $\frac{M \times 100}{10}$

where

$M$  = mass of the residue in the sintered glass crucible.

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\*Specification for water for general laboratory use ( second revision ).

†Methods of chemical analysis of manganese ores.

## A-5. DETERMINATION OF CHLORIDE

### A-5.1 Reagents

**A-5.1.1 Dilute Nitric Acid** — 1:9 ( v/v ).

**A-5.1.2 Silver Nitrate Solution** — 10 percent ( m/v ).

**A-5.1.3 Standard Chloride Solution** — Dissolve 1.6484 g of pure dry sodium chloride in water and dilute to 1 litre. Dilute 10 ml of this solution to one litre so that one ml contains 0.01 mg of chloride ( as Cl ).

### A-5.2 Apparatus

**A-5.2.1 Nessler Cylinder**

**A-5.3 Procedure** — Dissolve 1 g of the sample in water and dilute to 100 ml in a volumetric flask. To 10 ml of it taken in a 50-ml Nessler cylinder ( preserve the rest of the solution for Ca, Zn and Fe tests ), add 10 ml dilute nitric acid followed by two drops of silver nitrate solution, dilute with water and mix well. Any turbidity produced should not be greater than that produced in a control where 3 ml of standard chloride containing 0.01 mg of Cl per ml were treated in a similar manner.

## A-6. DETERMINATION OF MAGNESIUM AND ALKALI METALS AS SULPHATE

### A-6.1 Reagents

**A-6.1.1 Ammonium Carbonate Solution** — Dissolve 4 g of ammonium carbonate in a mixture of 5 ml of dilute ammonia and 20 ml of water.

### A-6.2 Apparatus

**A-6.2.1 Muffle Furnace**

### A-6.3 Procedure

**A-6.3.1** Dissolve 2 g of the sample in 30 ml of hot water, add 20 ml of freshly prepared ammonium carbonate solution and warm until the precipitate becomes granular. Filter, evaporate the filtrate to dryness in a tared crucible, add a few millilitres of concentrated sulphuric acid and ignite gently.

### A-6.4 Calculation

$$\text{Magnesium and alkali metals ( as SO}_4 \text{ ), percent by mass} = \frac{M \times 100}{2}$$

where

$M$  is the mass of the residue.

## A-7. DETERMINATION OF CALCIUM ( as Ca )

### A-7.1 Reagents

**A-7.1.1** *Ammonium Chloride* — 10·7 percent (  $m/v$  ).

**A-7.1.2** *Dilute Ammonia* — 40 percent (  $v/v$  ).

**A-7.1.3** *Dilute Hydrogen Peroxide* — 25 percent (  $v/v$  ).

**A-7.1.4** *Ammonium Oxalate Solution* — 3·5 percent (  $m/v$  ).

**A-7.1.5** *Standard Calcium Solution* — Dissolve 0·250 g of calcium carbonate (  $\text{CaCO}_3$  ) in 20 ml of water plus 5 ml of 10 percent hydrochloric acid and dilute with water to 1 litre. One millilitre of this solution is equivalent to 0·1 mg of Ca.

### A-7.2 Apparatus

**A-7.2.1** *Nessler Cylinder*

### A-7.3 Procedure

**A-7.3.1** Transfer 10 ml solution from **A-5.3** into a 100-ml beaker, add 2 ml of ammonium chloride followed by 10 ml dilute ammonia and 7 ml of dilute hydrogen peroxide with stirring. Boil to complete the precipitation, filter and wash the precipitate into a 50-ml Nessler cylinder where it is cooled to room temperature. Add 4 ml of ammonium oxalate solution, dilute to 50 ml, stir with glass rod and let stand for 20 minutes. Any turbidity produced should be not greater than that produced in a control where 0·2 mg of freshly prepared calcium were treated with 2 ml of ammonium chloride, 2 ml of dilute ammonia and 4 ml of ammonium oxalate in 50 ml volume, 20 minutes earlier.

## A-8. DETERMINATION OF ZINC ( as Zn )

### A-8.1 Reagents

**A-8.1.1** *Potassium Ferrocyanide* — 1 percent (  $m/v$  ),

**A-8.1.2** *Standard Zinc Solution* — Dissolve 0·62 g of zinc oxide,  $\text{ZnO}$ , in 10 ml of dilute sulphuric acid ( 1:9 ) and dilute with water to 1 litre. 1 ml of this solution is equivalent to 0·05 mg of Zn.

### A-8.2 Procedure

**A-8.2.1** Dilute 10 ml of solution from **A-5.3** to 25 ml with water in a test tube, add 1 ml of concentrated sulphuric acid followed by 1 ml of potassium ferrocyanide with continuous stirring for 5 minutes. Any turbidity produced after 5 minutes should be not greater than that produced in a control where 0·05 mg of freshly prepared zinc solution were treated in a similar manner.

**A-9. DETERMINATION OF IRON ( as Fe )****A-9.1 Reagents**

**A-9.1.1** *Concentrated Hydrochloric Acid* — see IS : 265-1976\*.

**A-9.1.2** *Potassium Permanganate* — 0.1 N.

**A-9.1.3** *Butanolic Potassium Thiocyanate Solution*

**A-9.2 Procedure**

**A-9.2.1** Transfer 10 ml of solution from **A-5.3** into a test tube, add 1 ml of concentrated hydrochloric acid followed by 3 drops of N/10 potassium permanganate and mix well. Add 10 ml of butanolic potassium thiocyanate to this, shake vigorously and allow the layers to separate. Any colour produced in the butanolic layer should be not deeper than that produced in a control where 0.005 mg of Fe were treated in a similar manner.

**A-10. DETERMINATION OF HEAVY METALS ( as Pb )****A-10.1 Reagents**

**A-10.1.1** *Dilute Acetic Acid* — 1 N.

**A-10.1.2** *Hydrogen Sulphide Water* — saturated.

**A-10.1.3** *Standard Lead Solution* — Dissolve 1.60 g of lead nitrate in water and make up the volume to exactly 1 000 ml. Transfer exactly 10 ml of the solution to a volumetric flask and dilute it again with water to 1 000-ml mark. One millilitre of this solution contains 0.01 mg of lead ( as Pb ). The solution shall be freshly prepared.

**A-10.2 Apparatus**

**A-10.2.1** *Nessler Cylinder*

**A-10.3 Procedure**

**A-10.3.1** Transfer 10 ml of the solution from solubility test from **A-3.2** to a 50-ml Nessler cylinder, add 0.02 mg of Pb followed by 1 ml of N/1 acetic acid and dilute to 40 ml. To a second Nessler cylinder, transfer 30 ml of solution from **A-4.1**, add 1 ml of N/1 acetic acid and dilute to 40 ml. Add 10 ml of hydrogen sulphide water to both. Any colour produced in the second Nessler cylinder should be not deeper than that produced in the first.

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\*Specification for hydrochloric acid ( second revision ).

## A-11. DETERMINATION OF ARSENIC

**A-11.1** Dissolve 10 g of the material in 40 ml of water. Carry out the test for arsenic as prescribed in IS : 2088-1971\* using for comparison a stain obtained with 0.005 mg of arsenic trioxide.

**A-11.1.1** The material shall be taken to have satisfied the requirement of the test if the length and intensity of the stain is not greater than that produced in the control test.

**A-11.1.2** *Potassium Iodide* — 20 percent ( *m/v* ).

## A-12. OXYGEN ABSORBED FROM PERMANGANATE

**A-12.1 Procedure** — Dissolve 1 g of the sample in 100 ml of freshly boiled and cooled distilled water. Add 2 ml of 5 N sulphuric acid and 1 ml of phosphoric acid. If a pink colour is produced on addition of 0.1 ml of 0.1 N potassium permanganate solution, then the sample is considered to have qualified the test.

## A-13. DETERMINATION OF AMMONIUM SULPHATE [ as ( $\text{NH}_4$ )<sub>2</sub> $\text{SO}_4$ ]

### A-13.1 Reagents

**A-13.1.1** *Sodium Hydroxide Solution* — 20 percent.

**A-13.1.2** *Standard Dilute Sulphuric Acid* — 1 N.

**A-13.1.3** *Standard Sodium Hydroxide Solution* — 1 N.

**A-13.2 Procedure** — Weigh accurately about 3.5 g of the sample into a 500-ml conical flask. Add 100 ml of water and 25 ml of sodium hydroxide solution. Boil and pass the issuing vapours through 50 ml standard sulphuric acid in a 500-ml conical flask for 30-40 minutes. Cool the acid to room temperature and titrate the excess of acid with standard sodium hydroxide solution using methyl red as indicator.

### A-13.3 Calculation

$$\begin{array}{l} \text{Ammonium sulphate} \\ \text{[ as ( } \text{NH}_4 \text{) }_2 \text{SO}_4 \text{ ],} \\ \text{percent by mass} \end{array} = \frac{(50 \times N_1 - V \times N_2) \times 0.066 \times 100}{M}$$

where

$N_1$  = factor of N/1 sulphuric acid,

$V$  = volume in ml of N/1 sodium hydroxide equivalent to excess of acid,

$N_2$  = factor of N/1 sodium hydroxide, and

$M$  = mass in g of the sample taken.

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\*Methods for determination of arsenic ( *first revision* ).

## APPENDIX B

( Clause 5.1 )

### SAMPLING OF MANGANESE SULPHATE, MONOHYDRATE

#### B-1. GENERAL REQUIREMENTS OF SAMPLING

**B-1.0** In drawing, preparing, storing and handling test samples, the following precautions and directions shall be observed.

**B-1.1** Precautions shall be taken to protect the samples, the material being sampled, the sampling instrument and the containers for samples from adventitious contamination.

**B-1.2** To draw a representative sample, the contents of each container selected for sampling shall be mixed as thoroughly as possible by suitable means.

**B-1.3** The samples shall be placed in suitable, clean, dry and air-tight glass or other suitable containers on which the material has no action.

**B-1.4** Each sample container shall be sealed air-tight after filling and marked with full details of sampling, the date of sampling and the year of manufacture of the material.

#### B-2. SCALE OF SAMPLING

**B-2.1 Lot** — All the containers in a single consignment of the material of one grade and drawn from a single batch of manufacture shall constitute a lot. If a consignment is declared or known to consist of different grades or batches of manufacture, the containers belonging to the same grade and batch shall be grouped together and each such group shall constitute a separate lot.

**B-2.1.1** Samples shall be tested from each lot for ascertaining conformity of the material to the requirements of the specification.

**B-2.2** The number ( $n$ ) of containers to be chosen from a lot shall depend on the size of the lot ( $N$ ) and shall be in accordance with col 1 and 2 of Table 2.

**B-2.3** The containers to be selected for sampling shall be chosen at random from the lot and for this purpose random number tables ( see IS : 4905-1968\* ) shall be used. In case such tables are not available, the following procedure may be adopted:

‘Starting from any container, count them 1, 2, 3, ....., up to  $r$  and so on in a systematic manner, where  $r$  is the integral part of  $N/n$ . Every  $r$ th container thus counted shall be taken out for drawing supplies.’

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\*Methods of random sampling.

**TABLE 2 NUMBER OF CONTAINERS TO BE SELECTED**  
( Clause B-2.2 )

LOT SIZE <i>N</i>	NUMBER OF CONTAINERS TO BE SELECTED <i>n</i>
(1)	(2)
3 to 50	3
51 to 200	4
201 to 400	5
401 to 650	6
651 and above	7

### **B-3. TEST SAMPLES AND REFEREE SAMPLE**

#### **B-3.1 Preparation of Test Samples**

**B-3.1.1** Draw with an appropriate sampling instrument a small portion of the material from different parts of each container selected. The total quantity of the material drawn from each container shall be sufficient to conduct the tests for all the characteristics given under **3** and shall not exceed 1 kg.

**B-3.1.2** Thoroughly mix all portions of the material drawn from the same container. Out of these portions a small but equal quantity shall be taken from each selected container and shall be well mixed up together so as to form a composite sample weighing not less than 600 g. This composite sample shall be divided into three equal parts, one for the purchaser, another for the supplier and the third to be used as referee sample.

**B-3.1.3** The remaining portion of the material from each container ( after a small quantity needed for the formation of composite sample has been taken ) shall be divided into three equal parts, each part weighing not less than 100 g. These parts shall be immediately transferred to thoroughly dried bottles which are then sealed air-tight with stoppers and labelled with all the particulars of sampling given under **B-1.4**. The material in each such sealed bottle shall constitute an individual test sample. These individual samples shall be separated into three identical sets of samples in such a way that each set has an individual test sample representing each container selected. One of these three sets shall be sent to the purchaser, another to the supplier and the third shall be used as referee sample.



**B-3.2 Referee Sample** — The referee sample shall consist of the composite sample ( *see* **B-3.1.2** ) and a set of individual sample ( *see* **B-3.1.3** ) marked for this purpose and shall bear the seals of the purchaser and the supplier. These shall be kept at a place agreed to between the purchaser and the supplier and shall be used in case of dispute between the two.

## **B-4. NUMBER OF TESTS**

**B-4.1** Tests for the determination of manganese sulphate, monohydrate shall be conducted on each of the individual samples for all the grades.

**B-4.2** Tests for the remaining characteristics shall be conducted on the composite sample.

## **B-5. CRITERIA FOR CONFORMITY**

### **B-5.1 For Individual Samples**

**B-5.1.1 For Manganese Sulphate** — The test results for manganese sulphate, monohydrate shall be recorded, and the mean and the range for these test results shall be calculated as follows:

Mean (  $\bar{X}$  ) = Sum of the test results divided by the number of test results, and

Range (  $R$  ) = The difference between the maximum and the minimum values of the test results.

The value of expression (  $\bar{X} \pm 0.6 R$  ) shall be calculated. If the values of this expression lie within the limits specified for the relevant grade in Table 1, the lot shall be declared to have satisfied the requirement for this characteristic.

**B-5.2 For Composite Sample** — The test results on the composite sample shall meet the corresponding requirements specified in Table 1 for the relevant grade.

**B-5.3** A lot shall be declared as conforming to the specification if it satisfies the requirements for each of the characteristics listed in Table 1 for the relevant grade.

# INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

## Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

## Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>